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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application Transmittal

Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the **Patent Application** of:

Inventor: G. Cuomo, et al

For: Method and Apparatus for Affinity of Users to Application Servers

Enclosed are:

- [✓] Five (5) sheets of drawings.
- [✓] An assignment of the invention to International Busines Machines Corporation, Armonk, New York 10504.
- [ ] A certified copy of a _____ application.
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- [✓] Declaration and Power of Attorney for Patent Application

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Date: July 28, 2000

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Catherine M. Robbins
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Docket No. RSW9-2000-0090US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: G. Cuomo, et al

Serial No.: Group No.:

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Docket No. RSW9-2000-0090-US1

METHOD AND APPARATUS FOR AFFINITY OF USERS TO APPLICATION SERVERS

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates to an improved data processing system and, in particular, to a method and apparatus for managing sessions in a client/server environment. Still more particularly, the present invention provides a method and apparatus for routing requests to application servers based on a hash of the session identification.

2. Description of Related Art:

The worldwide network of computers commonly known as the "Internet" has seen explosive growth in the last several years. Mainly, this growth has been fueled by the introduction and widespread use of so-called "web browsers," which enable simple graphical user interface-based access to network servers, which support documents formatted as so-called "web pages." A browser is a program that is executed on a graphical user interface (GUI) in a client computer. The browser allows a user to seamlessly load documents from a server via the Internet and display them by means of the GUI. These documents are commonly formatted using markup language protocols, such as hypertext markup language (HTML).

The client and the web server typically communicate using hypertext transport protocol (HTTP). However, when

a client is accessing sensitive information from a web server, a secure protocol may be used. Hypertext transport protocol secure (HTTPS) is the protocol for accessing a secure Web server. Using HTTPS in the uniform resource locator (URL) instead of HTTP directs the message to a secure port number rather than the default Web port number of 80. The session is then managed by a security protocol. Secure sockets layer (SSL) is the leading security protocol on the Internet. When an SSL session is started, the browser sends its public key to the server so that the server can securely send a secret key to the browser. The browser and server exchange data via secret key encryption during that session.

HTTP is a stateless protocol. Therefore, every request from an HTTP client to an HTTP server is a new request and no state is maintained between requests. Conventionally, HTTP cookies are used to maintain a client-side state whereas HTTP sessions are used to manage the state information on the server side. A cookie is data created by a web server that is stored on a client computer. A cookie is used to keep track of a user's patterns and preferences and, with the cooperation of the Web browser, is stored within the client computer. Cookies contain a range of URLs for which they are valid. When the browser encounters those URLs again, it sends the appropriate cookies to the Web server.

A session is used to track the activities of a user. For example, a session may be created to allow a user to add items to a "shopping cart" using a plurality of

individual requests. A session may also allow a user to use a web interface to search a database. Web interfaces may also be used to control equipment from remote locations. As web interfaces become increasingly popular, the administration of sessions used to manage multiple transactions by individual clients becomes exceedingly important. Normally, an HTTP session is created on the server side. To associate a session with a user, a number, referred to as a session identification (ID), is generated and associated with the user. The session ID is sent back to the browser as a cookie or through a URL rewriting mechanism.

However, web sites with high traffic employ a plurality of application servers to serve requests. One or more web servers route requests to the application servers and attempt to balance the loads on the servers. Prior art application servers embed knowledge into a session ID to identify the application server upon subsequent requests. When a client submits a request with a session ID, the web server must then extract that knowledge from the session ID to route the request to the proper application server.

One manner in which the server identification is embedded into the session ID is to encode a server:port pair into the session ID. This technique provides load balancing provided the initial request was load balanced properly. A plurality, usually two, of server:port pairs may also be encoded into the session ID. Thus, if the first server is not functional, another server may fulfill the request. However, this technique requires

that the servers encoded into the session ID share the session information. Conventionally, the session information is shared by replication between "server buddies." As the number of servers encoded into the session ID increases, the amount of replication increases, using up more storage. The level of fault tolerance in this technique is limited to the number of server:port pairs encoded into the session ID.

Another manner in which the server identification is embedded into the session ID is to encode an index into the session ID. This technique provides load balancing provided the initial request was load balanced properly. This technique provides no fault tolerance, because if the indexed server encoded in the session ID is down, the session data is lost.

Embedding the application server identification also has the disadvantage of tying the application server and web server code. The web server must know the manner in which the server identification is encoded into the session ID to extract the server identification and route a request. Furthermore, the application servers do not efficiently share session data.

Therefore, it would be advantageous to have an improved method and apparatus for perform routing of requests to application servers independent of information embedded in the session identification.

SUMMARY OF THE INVENTION

The present invention provides a plurality of application servers, which share a database through a shared data mechanism. The application servers store session data in the shared data mechanism; therefore, if a subsequent request is routed to a different application server, the session data is available through the shared data mechanism. One or more web servers perform routing of requests to the application server. When a request is received that is accompanied by a session ID, routing is performed by utilizing a hash function on the session ID. The resulting hash value is mapped to an application server. A hash function on a session ID will always result in the same hash value; therefore, the request will always be routed to the same application server. However, if an application server is non-functional, a new hash based on the previous hash is computed until a functional application server is selected.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 depicts a pictorial representation of a distributed data processing system in which the present invention may be implemented;

Figure 2 is a block diagram of a data processing system that may be implemented as a server in accordance with a preferred embodiment of the present invention;

Figure 3 is a block diagram illustrating a data processing system in which the present invention may be implemented;

Figure 4 depicts a specific client/server arrangement according to a preferred embodiment of the present invention;

Figure 5 is a diagram illustrating a look-up table for selecting an application server in accordance with a preferred embodiment of the present invention; and

Figure 6 is a flowchart illustrating the operation of a web server according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures, **Figure 1** depicts a pictorial representation of a distributed data processing system in which the present invention may be implemented. Distributed data processing system **100** is a network of computers in which the present invention may be implemented. Distributed data processing system **100** contains a network **102**, which is the medium used to provide communications links between various devices and computers connected together within distributed data processing system **100**. Network **102** may include permanent connections, such as wire or fiber optic cables, or temporary connections made through telephone connections.

In the depicted example, a server **104** is connected to network **102** along with storage unit **106**. In addition, clients **108**, **110**, and **112** also are connected to network **102**. These clients **108**, **110**, and **112** may be, for example, personal computers or network computers. For purposes of this application, a network computer is any computer, coupled to a network, which receives a program or other application from another computer coupled to the network. In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients **108-112**. Clients **108**, **110**, and **112** are clients to server **104**. Distributed data processing system **100** may include additional servers, clients, and other devices not shown. In the depicted example, distributed data processing system **100** is the Internet with network **102** representing a worldwide collection of networks and

gateways that use the TCP/IP suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial, government, educational and other computer systems that route data and messages. Of course, distributed data processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area network (WAN). **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI bus **216**. Typical PCI bus implementations will support

four PCI expansion slots or add-in connectors. Communications links to network computers **108-112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI buses **226** and **228**, from which additional modems or network adapters may be supported. In this manner, data processing system **200** allows connections to multiple network computers. A memory-mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

The data processing system depicted in **Figure 2** may be, for example, an IBM RISC/System 6000 system, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive Executive (AIX) operating system.

With reference now to **Figure 3**, a block diagram illustrating a data processing system in which the present invention may be implemented. Data processing system **300** is an example of a client computer. Data processing system **300** employs a peripheral component interconnect

(PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. Small computer system interface (SCSI) host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **302** and is used to coordinate and provide control of various components within data processing system **300** in **Figure 3**. The operating system may be a commercially available operating system, such as Windows 2000, which is available from Microsoft Corporation. An object oriented programming system such as Java may run in conjunction with the

operating system and provides calls to the operating system from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or programs are located on storage devices, such as hard disk drive **326**, and may be loaded into main memory **304** for execution by processor **302**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash ROM (or equivalent nonvolatile memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

For example, data processing system **300**, if optionally configured as a network computer, may not include SCSI host bus adapter **312**, hard disk drive **326**, tape drive **328**, and CD-ROM **330**, as noted by dotted line **332** in **Figure 3** denoting optional inclusion. In that case, the computer, to be properly called a client computer, must include some type of network communication interface, such as LAN adapter **310**, modem **322**, or the like. As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interface, whether or not data processing system **300** comprises some type of network communication interface. As a further

example, data processing system **300** may be a Personal Digital Assistant (PDA) device, which is configured with ROM and/or flash ROM in order to provide non-volatile memory for storing operating system files and/or user-generated data.

The depicted example in **Figure 3** and above-described examples are not meant to imply architectural limitations. For example, data processing system **300** also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing system **300** also may be a kiosk or a Web appliance.

With reference now to **Figure 4**, a specific client/server arrangement is presented according to a preferred embodiment of the present invention. A network, such as Internet **402**, connects clients **404**, **406** and web servers **408**, **410**. In the depicted example, the network is the Internet; however, any network that supports HTTP protocol or uses a protocol that requires the use of sessions may be implemented.

The web servers may perform functions to serve HTTP requests; however, for the purposes of the present invention web servers **408**, **410** perform routing to application servers **412**, **414**, and **416** through communication channel **418**. Communication channel **418** may be an intranet, a local area network (LAN), or a wide area network (WAN). While the example shown in **Figure 4** comprises two web servers and three application servers, any combination of web servers and application servers may be used. As a minimum example, the present invention may employ a single web server, such as web server **408**,

routing requests to two application servers, such as servers **412**, **414**.

Application servers **412**, **414**, and **416** access database **420** through backend DBMS **422**. The application servers store session data in the database. Thus, if an application server is non-functional or a subsequent request in a session is otherwise routed to a different application server, the session data may be retrieved and the request may be fulfilled. In an alternate embodiment, each application may have session data stored in internal storage and replicated in the centralized database. Other known distributed database techniques may be used to share session data. Furthermore, while the depicted example uses a shared database, any shared data mechanism, such as a shared file system or shared memory, may be used.

When an initial HTTP request without a session ID is received by a web server, such as web server **408**, the request is routed to an application server, such as application server **412**, using conventional load balancing techniques. However, when an HTTP request is received with a session ID, the web server performs a hash function on the session ID.

A hash function *H*, as is known in the art, is a transformation that takes an input message, referred to as *m*, and returns a fixed-size string, which is called the hash value *h*. The input may be of any length; however, the output has a fixed length. Given the same input *m*, a hash function will always produce the same hash value *h*; however, no two messages m_1 and m_2 should

produce the same value *h*. Two messages that are hashed to produce the same hash value are referred to as a collision. A weakly collision-free hash function is one for which it is computationally infeasible, given a message m_1, to find an m_2 such that $H(m_1) = H(m_2)$. A strongly collision-free hash function is one for which it is computationally infeasible to find any two messages m_1 and m_2 such that $H(m_1) = H(m_2)$.

Typically, hash functions are used to provide a smaller "finger print" of a message to be digitally signed or time stamped. Examples of well-known hash functions are message digest 2 (MD2) and message digest 5 (MD5). Hash functions may also be used to form an index for more efficient searching. However, in the present invention, the hash function is used to produce an integer to select an application server, because each session ID will always result in the same hash value. A good hash function that distributes evenly across the application servers allows the requests to be load balanced across the application servers.

Once the hash function is computed, the web server performs a modulus function (mod) on the hash value based on the number of application servers. A modulus function divides an integer into another integer and returns the remainder. For example, for *N* application servers, *h mod N* will result in an integer *i* between zero and *N-1*. The web server then uses a look-up table to map the integer *i* to an application server.

Turning now to **Figure 5**, a diagram is shown illustrating a look-up table for selecting an application

server in accordance with a preferred embodiment of the present invention. The columns of the look-up table include *Integer (i)* indicating the integer obtained from the session ID, *Server* indicating a host_name:port pair identifying the server, and *Down* indicating whether the application server is down.

As an example, a session ID may result in a value of zero after the hash function and modulus function are performed. The web server selects server0:port and determines that the selected application server is not down. Thus, the web server routes the request to server0:port. As a further example, a session ID may result in a value of two after the hash function and modulus function are performed. The web server selects server2:port and determines that the selected application server is down. Then, the web server performs a hash function on the result of the previous hash function. A modulus function performed on the new hash value may result in a value of one. The web server then selects server1:port and determines that the selected application server is not down. Thus, the web server routes the request to server1:port.

With reference now to **Figure 6**, a flowchart is shown illustrating the routing of a request by a web server according to a preferred embodiment of the present invention. The process begins and the web server receives a request (step **602**). A determination is made as to whether the request includes a session ID (step **604**). If the request does not include a session ID, the web server routes the request to an application server

with load balancing in a known manner (step **606**) and the process ends.

If the request includes a session ID in step **604**, the process sets m equal to the session ID and an integer *n* equal to zero (step **608**) and performs a hash function *H* on *m* with an initial value of *n* (step **610**) resulting in a hash value *h*. The process then sets an integer *i* equal to *h mod N*, where *N* is the number of application servers (step **612**). Thereafter, the process selects an application server from a look-up table using *i* (step **614**) and a determination is made as to whether the server is down (step **616**). The determination may be made simply by checking the appropriate column in the look-up table. The web server must then update the look-up table whenever a server goes down or returns to a functional state. In an alternate embodiment, the determination is made by performing a test of the server or by routing the request to the server and waiting for an error message to be returned.

If the server is not down, the web server routes the request to the application server selected from the table (step **618**) and the process ends. If the server is down in step **616**, the process sets *n* equal to *h* (step **620**) and returns to step **610** to recompute the hash function. The web server recomputes the hash function until a functional application server is selected. In an alternate embodiment, the process merely increments the value of *n* in step **620** and returns to step **610** to recompute the hash function.

Thus, the present invention solves the disadvantages of the prior art by providing a plurality of application servers, which share a database through a backend database management system (DBMS). The application servers store session data in the database; therefore, if a subsequent request is routed to a different application server, the session data is available through the backend DBMS. One or more web servers perform routing of requests to the application server. Load balancing is achieved by utilizing a hash function on the session ID and routing based on the result of the hash function. Fault tolerance is achieved by recomputing a new hash based on the previous hash until a functional application server is selected. The use of a hash function to determine routing allows the web server to ignore the content of the session ID. Therefore, prior art application servers, which embed information into the session ID, may be used.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard

disk drive, a RAM, and CD-ROMs and transmission-type media such as digital and analog communications links.

The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. For example, HTTP is used as the protocol in the depicted examples; however, the present invention may be implemented using other protocols. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS:

What is claimed is:

1. A method in a data processing system for managing a request including a session identification, comprising:

calculating a first value based on the session identification; and

routing the request to a server based on the first value.

2. The method of claim 1, wherein the step of calculating a first value comprises performing a hash function on the session identification.

3. The method of claim 2, wherein the step of routing the request to a server comprises:

performing a modulus function on the first value to form a first integer; and

selecting a server based on the first integer.

4. The method of claim 3, wherein the step of selecting a server comprises looking up the server in a look-up table using the first integer.

5. The method of claim 1, wherein the step of routing the request to a server comprises:

selecting a first server based on the first value;

determining whether the first server is functional; and

routing the request to the first server in response to the first server being functional.

6. The method of claim 5, further comprising:

calculating a second value based on the first value in response to the first server being non-functional; and

routing the request to a second server based on the second value.

7.The method of claim 5, wherein the step of determining whether the first server is functional comprises using a look-up table.

8. A method in a data processing system for routing a request to one of a number of servers, comprising:

receiving a request including a session identification;

performing a hash function on the session identification to form a hash value;

performing a modulus function on the hash value to form an integer; and

routing the request to one of the number of servers based on the integer.

9. The method of claim 8, wherein the integer is between zero and the number of servers minus one.

10. The method of claim 8, wherein the step of routing the request comprises looking up the server in a look-up table using the integer.

11. An apparatus for managing a request including a session identification, comprising:

calculation means for calculating a first value based on the session identification; and

routing means for routing the request to a server based on the first value.

12. The apparatus of claim 11, wherein the calculation means comprises hash means for performing a hash function on the session identification.

13. The apparatus of claim 12, wherein the routing means comprises:

modulus means for performing a modulus function on the first value to form a first integer; and

selection means for selecting a server based on the first integer.

14. The apparatus of claim 13, wherein the selection means comprises table means for looking up the server in a look-up table using the first integer.

15. The apparatus of claim 11, wherein the routing means comprises:

selection means for selecting a first server based on the first value;

determining means for determining whether the first server is functional; and

means for routing the request to the first server in response to the first server being functional.

16. The apparatus of claim 15, further comprising:

means for calculating a second value based on the first value in response to the first server being non-functional; and

means for routing the request to a second server based on the second value.

17. The apparatus of claim 15, wherein the determining means uses a look-up table.

18. An apparatus for routing a request to one of a number of servers, comprising:

a processor; and

a memory electrically connected to the processor, the memory having stored therein a program to be executed on the processor for performing:

receiving a request including a session identification;

performing a hash function on the session identification to form a hash value;

performing a modulus function on the hash value to form an integer; and

routing the request to one of the number of servers based on the integer.

19. The apparatus of claim 18, wherein the integer is between zero and the number of servers minus one.

20. The apparatus of claim 18, wherein the step of routing the request comprises looking up the server in a look-up table using the integer.

21. A distributed processing system comprising:

a client computer;

a first application server;

a second application server;

a web server, connected to the client computer, the first application server, and the second application server, the web server for routing a request from the client computer to one of the first application server and the second application server; and

a database, connected to the first application server and the second application server, for storing session data associated with the request.

22. The system of claim 21, wherein the web server routes the request to the first application server and the first application server establishes a session with the client computer and generates a session identification.

23. The system of claim 22, wherein the first application server stores the session data in the database.

24. The system of claim 23, wherein the web server receives a second request including the session

identification, performs a calculation on the session identification to form a value and routes the request to the second application server based on the value.

25. A computer program product, in a computer readable medium, for managing a request including a session identification, comprising:

instructions for calculating a first value based on the session identification; and

instructions for routing the request to a server based on the first value.

26. A computer program product, in a computer readable medium, for routing a request to one of a number of servers, comprising:

instructions for receiving a request including a session identification;

instructions for performing a hash function on the session identification to form a hash value;

instructions for performing a modulus function on the hash value to form an integer; and

instructions for routing the request to one of the number of servers based on the integer.

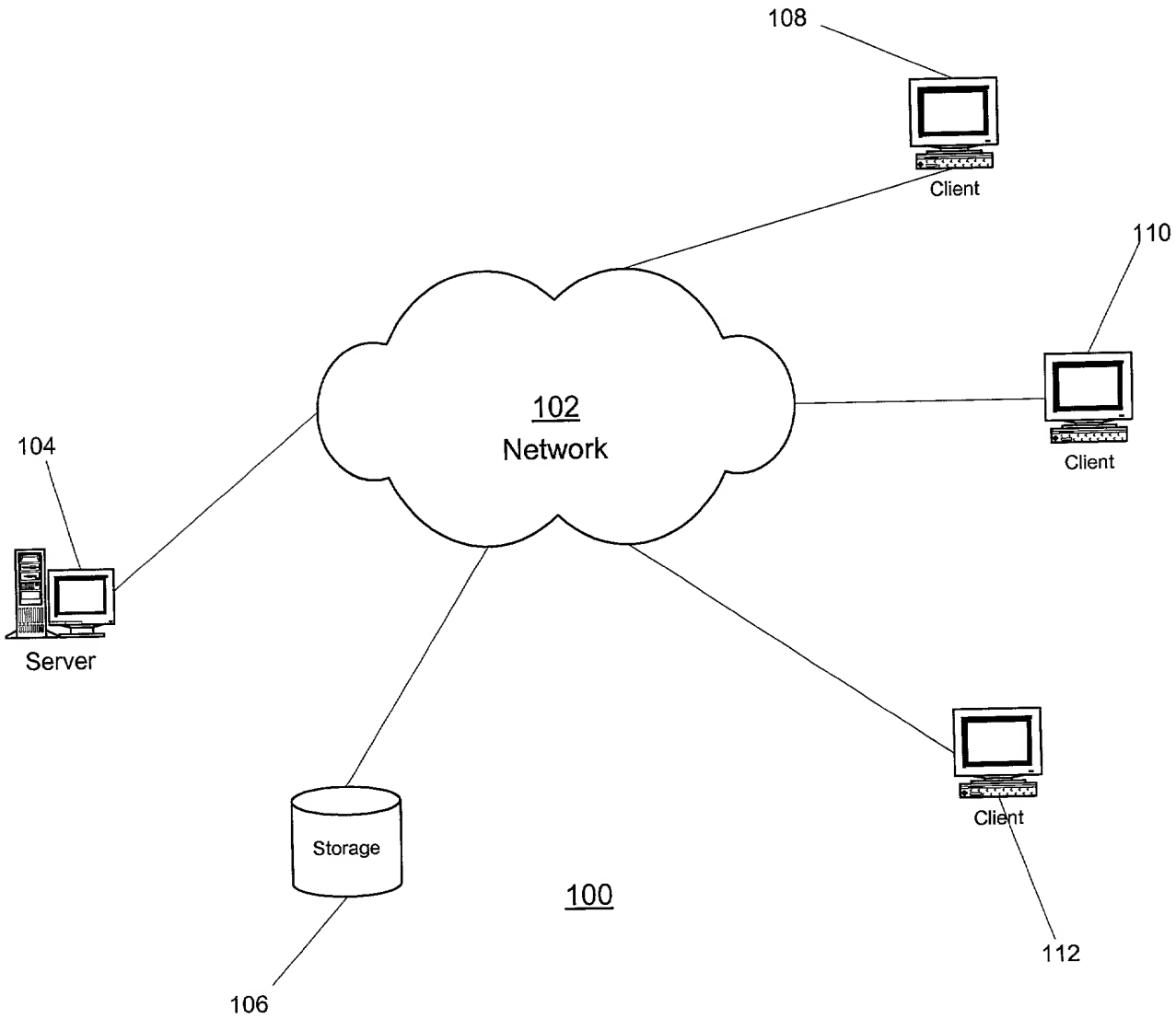
ABSTRACT OF THE DISCLOSURE

METHOD AND APPARATUS FOR AFFINITY OF USERS TO APPLICATION SERVERS

A method and apparatus route hypertext protocol requests to one of a plurality of application servers, which share a database through a backend database management system. The application servers store session data in the database. Hence, if a subsequent request is routed to a different application server, the session data is available through the backend database management system. One or more web servers perform routing of requests to the application server. When a request is received that is accompanied by a session ID, routing is performed by utilizing a hash function on the session ID. The resulting hash value is mapped to an application server. A hash function on a session ID will always result in the same hash value; therefore, the request will always be routed to the same application server. However, if an application server is non-functional, a new hash based on the previous hash is computed until a functional application server is selected.

Figure 1

RSW9-2000-0090-US1



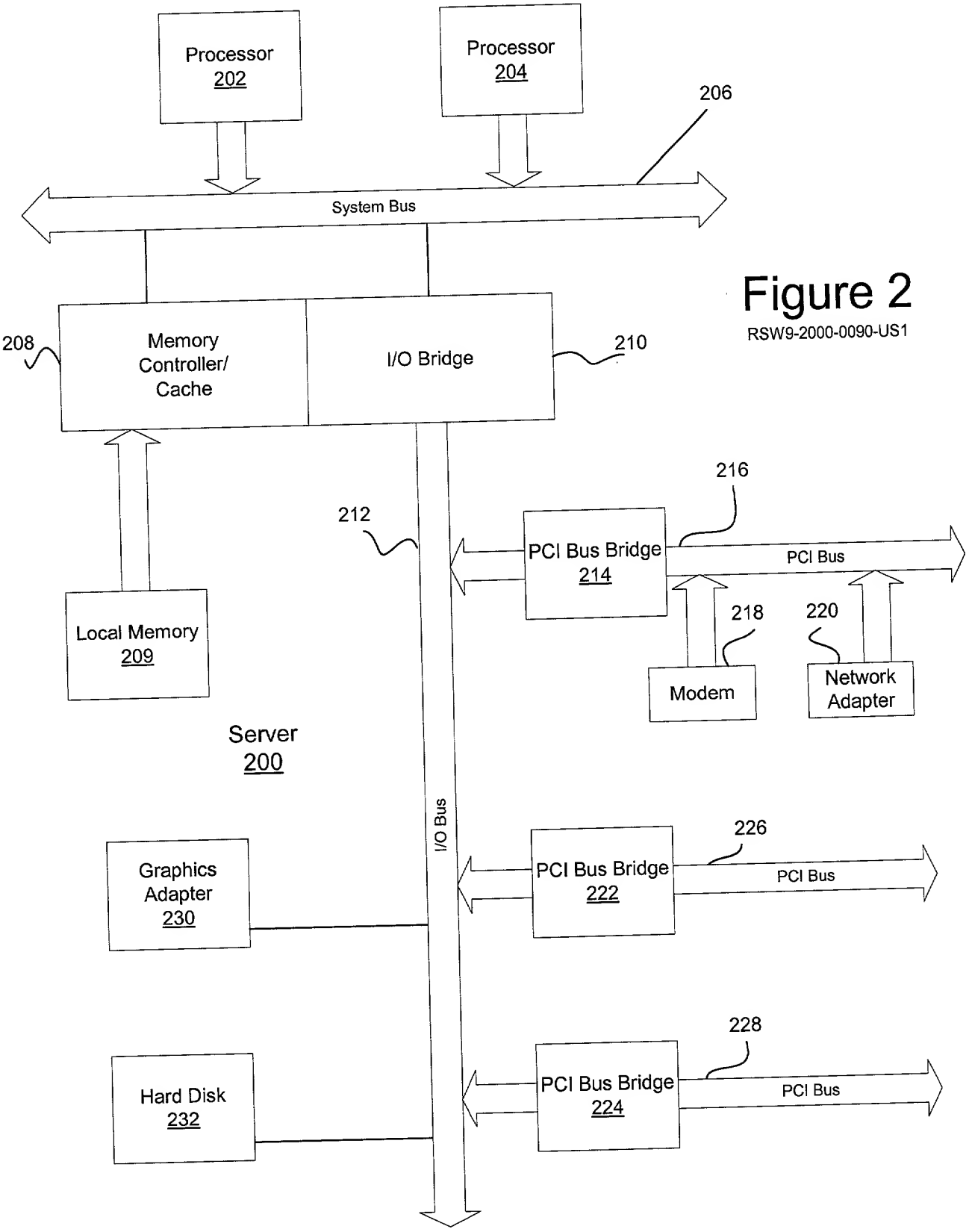


Figure 2

RSW9-2000-0090-US1

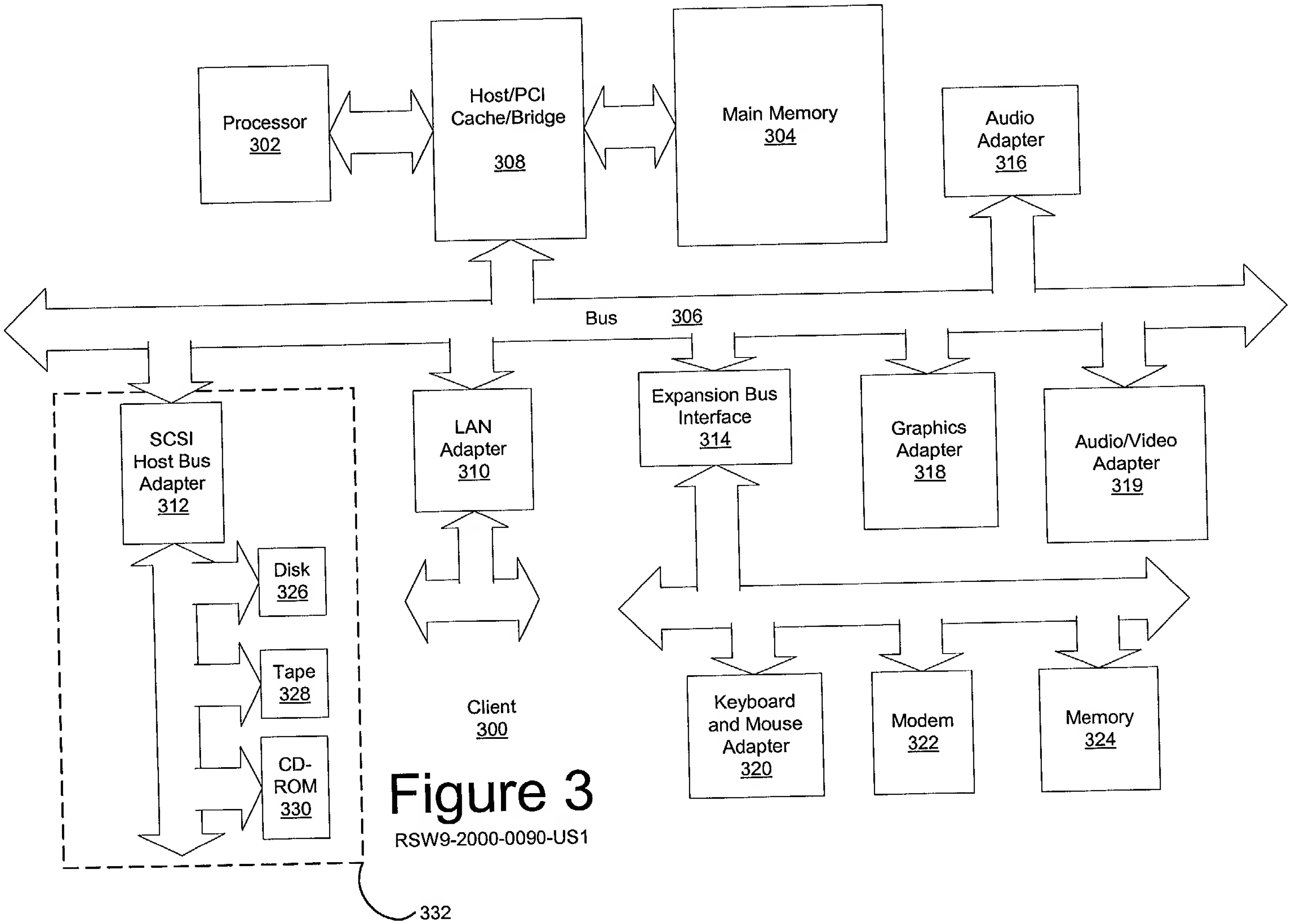


Figure 3

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Figure 4

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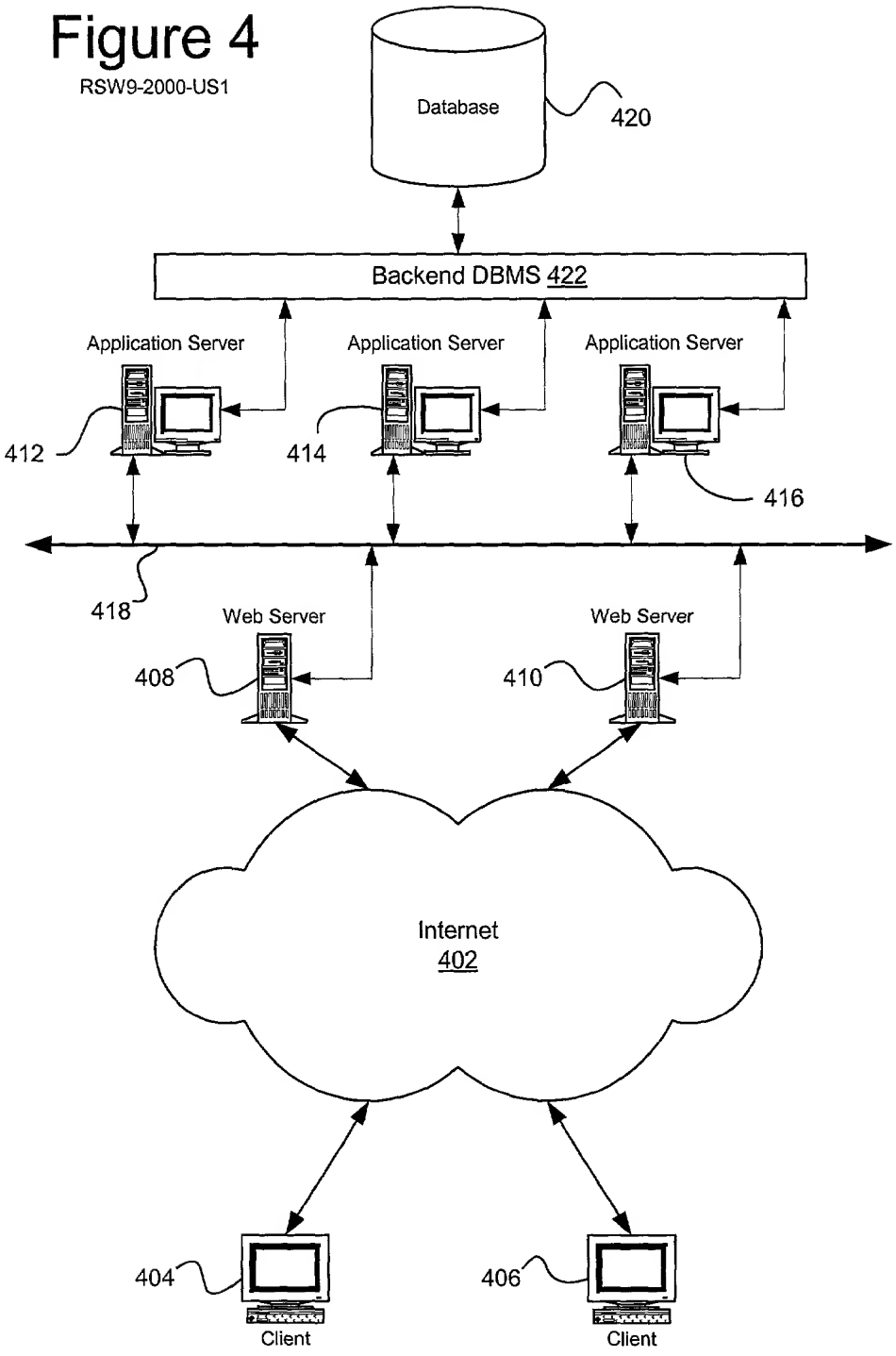

Figure 5

RSW9-2000-0090-US1

Integer (i)	Server	Down
0	server0:port	no
1	server1:port	no
2	server2:port	yes
. . .	. . .	. . .
N-1	serverN-1:port	no

Figure 6

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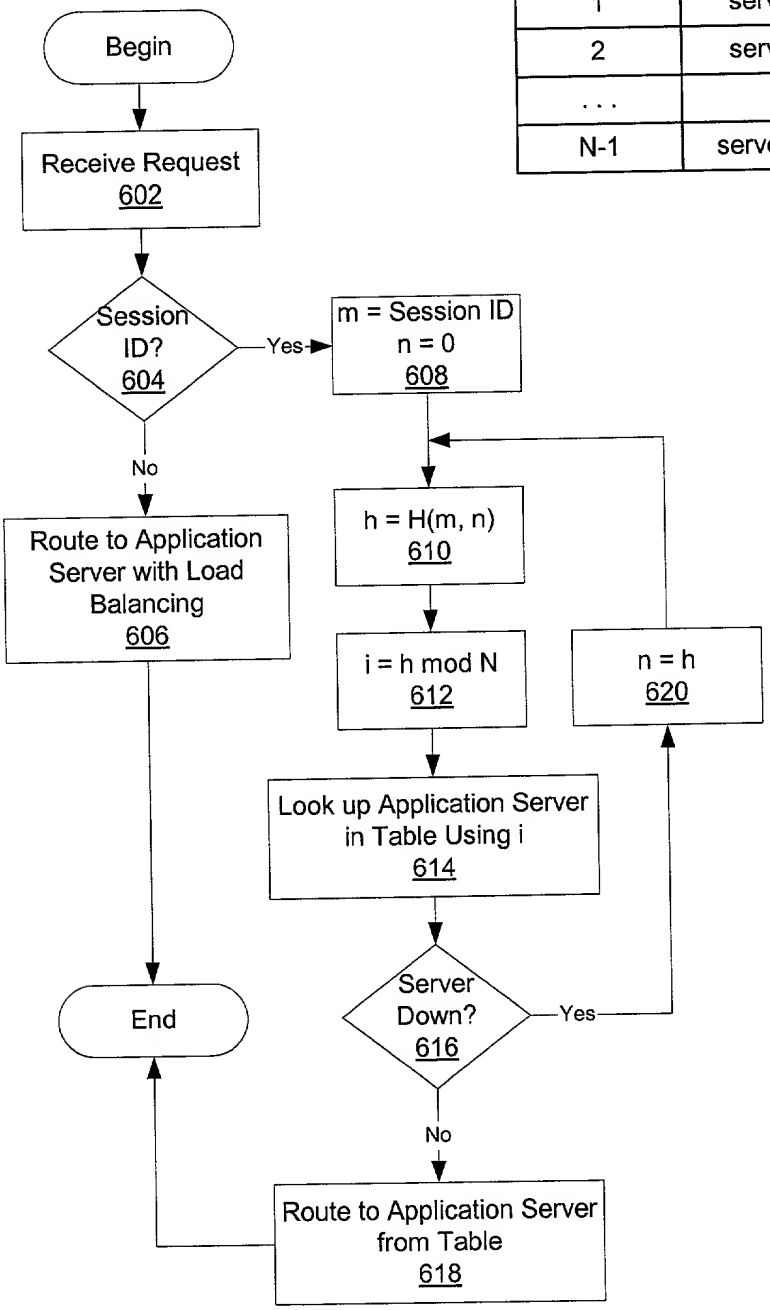

Declaration and Power of Attorney for Patent Application

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR AFFINITY OF USERS TO APPLICATION SERVERS

the specification of which (check one)

☑ is attached hereto.

☐ was filed on _____ as Application Serial No. _____.

I hereby state that I have reviewed and understand the contents of the above- identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):

Number	Country	Day/Month/Year	Priority Claimed

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information material to the patentability of this application as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U.S. Applications:

Serial No.	Filing Date	Status

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

As a named inventor, I hereby appoint the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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